

1 20. The apparatus of claim 19 wherein said fourth subset of computer
2 instructions controls said remote microwave plasma system to direct said microwave energy at
3 a power level ranging from about 150-500 W to ignite said plasma in said applicator.

1 21. (New) A method of removing residue from a substrate processing
2 chamber, said method comprising:
3 forming a flow of reactive radicals generated in a remote plasma outside of said
4 chamber;
5 forming a nonplasma gas flow;
6 mixing said flow of said reactive radicals and said nonplasma gas flow anterior
7 to said chamber to form a gas-radical mixture; and
8 flowing said gas-radical mixture into said chamber.

REMARKS

Claims 1-21 are pending. The specification has been amended to correct informalities. Claims 3-12, and 16 have been amended to correct informalities, and to more particularly point out and distinctly claim Applicants' invention. New claim 21 has been added. No new matter has been introduced.

Applicants respectfully assert that claims 1-20 are patentable over the cited references because, for instance, none of the references disclose or suggest a method or an apparatus for mixing a flow of reactive radicals and a diluent gas flow anterior to a chamber to form a gas-radical mixture. In the present invention, producing the gas-radical mixture anterior of the chamber allows increasing the flow rate of a gas through the chamber, while decreasing the rate at which materials located within the chamber are etched by the reactive radicals dispersed within the gas-radical mixture (page 4, lines 15-18). The references are completely devoid of any suggestion for the recited features.

Claims 1-4, 6, 8, 9, and 11-15 Are Novel over Kawamura

Claims 1-4, 6, 8, 9, and 11-15 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Kawamura (U.S. Patent No. 5,328,558).

Applicants respectfully submit that claims 1-4 and 6 are novel and patentable over Kawamura because, for instance, Kawamura does not disclose mixing a flow of reactive

radicals and a diluent gas flow anterior to a chamber to form a gas-radical mixture, and flowing the gas-radical mixture into the chamber in a method of removing residue from a substrate processing chamber, as recited in claim 1 from which claims 2-4 and 6 depend.

Kawamura has nothing to do removing residue from a chamber, but discloses flowing plasma-activated species of an NF_3/H_2 mixture as a feed gas for an etchant for etching SiO_2 on a silicon wafer. "The NF_3/H_2 mixed ratio of the mixture is so set as not the effect the etching of the SiO_2 film under a chemical action. Then the absorbed activated species are irradiated with Ar low energy ions so that the activated species are excited and etch the SiO_2 film." Abstract (emphasis added). In Kawamura, the NF_3/H_2 is activated by plasma and flowed into the chamber. The flow is stopped by closing valves (36) and (38), and then the valve (50) for the Ar gas is opened to feed the Ar gas into the chamber, which is made into plasma by the high-frequency power source (56) and magnet coil (58) to excite the activated species absorbed in the SiO_2 film (col. 6, lines 12-36).

Kawamura does not teach mixing reactive radicals and a diluent gas flow anterior to the chamber to form a gas-radical mixture. Therefore, claims 1-4 and 6 are novel and patentable over Kawamura.

Applicants further submit that claims 8, 9, and 11-15 are novel and patentable over Kawamura because, for instance, Kawamura fails to teach means for mixing a flow of reactive radicals and a diluent gas flow anterior to the chamber to form a gas-radical mixture, as recited in claim 8 from which claims 9 and 11-15 depend. As discussed above, Kawamura is devoid of any disclosure for mixing a flow of reactive radicals and a diluent gas flow anterior to the chamber. Accordingly, claims 8, 9, and 11-15 are novel and patentable over Kawamura.

Claims 1-15 Are Novel over Moslehi

Claims 1-15 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Moslehi (U.S. Patent No. 5,403,434).

Applicants respectfully submit that claims 1-15 are novel and patentable over Moslehi. For example, Moslehi does not teach mixing a flow of reactive radicals and a diluent gas flow anterior to a chamber to form a gas-radical mixture, and flowing the gas-radical mixture into the chamber, as recited in claim 1 from which claims 2-7 depend. Nor does

Moslehi disclose means for mixing a flow of reactive radicals and a diluent gas flow anterior to the chamber to form a gas-radical mixture, as recited in claim 8 from which claims 9-15 depend.

Moslehi discloses a digermane-assisted dry cleaning process. For plasma activation, Moslehi injects "a remote plasma stream of H₂, Ar/He (or other inert gas such as He or Xe), or an H₂+Ar/He mixture" (col. 11, lines 37-39). While "some or all of the digermane gas and the HCl/HBr and HF additives can also be introduced in the plasma stream, these components of the cleaning process stream are introduced as downstream non-plasma gases" (col. 11, lines 40-44). The inert gas plasma streams "interact with the non-plasma injected gas molecules, exciting them and causing process activation" (col. 11, lines 62-65).

Moslehi does not teach mixing a diluent gas flow with a flow of reactive radicals to form a gas-radical mixture, and is devoid of any suggestion for doing so anterior to the chamber. Instead, Moslehi discloses either introducing digermane gas and additives with inert gases in a remote plasma stream into the chamber, or using an inert gas plasma to excite downstream non-plasma digermane gas and additives in the chamber. Neither the plasma inert gases nor the digermane gas and additives constitute a diluent gas flow, and there is no mixing of reactive radicals and a diluent gas anterior of the chamber.

For at least the foregoing reasons, claims 1-15 are novel and patentable over Moslehi.

Claims 16-20 Are Patentable over Kawamura or Moslehi in view of Stevens et al.

Claims 16-20 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kawamura or Moslehi in view of Stevens et al. (U.S. Patent No. 5,302,803).

Applicants respectfully assert that claims 16-20 are patentable over the cited references because, for instance, they fail to disclose or suggest a mixing manifold and a pump system to create a diluent gas flow and a flow of the reactive radicals to the mixing manifold to combine the diluent gas flow and the flow of the reactive radicals to form a gas-radical mixture egressing from the outlet of the mixing manifold and traversing through the intake port of the chamber, as recited in claim 16 from which claims 17-20 depend.

As discussed above, Kawamura does not teach a mixing manifold for mixing a diluent gas flow and a flow of reactive radicals, but discloses separately flowing activated

species of NF_3/H_2 first and then an Ar gas into the chamber. Moslehi also fails to disclose the recited mixing manifold. In Moslehi, the inert gases and digermane gas and additives are either injected in the remote plasma stream, or the inert gases are injected in the remote plasma stream into the chamber and the digermane gas and additives are introduced into the chamber separately as downstream non-plasma gases. Stevens et al. merely discloses a microwave plasma apparatus, and does not supply the teachings missing from Kawamura and Moslehi.

For at least the foregoing reasons, Applicants respectfully submit that claims 16-20 are patentable over the cited references.

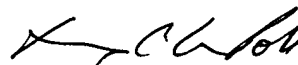
Furthermore, Applicants believe that new claim 21 is patentable over the cited references because, for instance, none of them disclose or suggest mixing a flow of reactive radicals from a remote plasma and a flow of nonplasma gas flow anterior to a chamber to form a gas-radical mixture, and flowing the gas-radical mixture into the chamber.

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 650-326-2400.

Respectfully submitted,



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